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The Reliability of Quarterly
National Accounts in Seven
Major Countries: A User's
Perspective

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**by
Robert York and Paul Atkinson**

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The Reliability of Quarterly National Accounts in Seven Major Countries: A User's Perspective

National accounts data provide the most comprehensive overview available of developments in national economies. They are of great interest to a wide range of users of economic information. These users, which include governments formulating budgetary policies, central banks making monetary policy decisions, businesses considering investment decisions and financial institutions making judgements concerning portfolio allocation, have needs which may differ in various respects. However, since their interest generally stems from the likelihood that they will make better decisions if they are well informed about economic developments, they all have a strong interest in the accuracy of national accounts statistics. This paper examines the reliability of preliminary quarterly national accounts statistics. In particular, it considers the longer-term behaviour of the provisional estimates to GDP growth and its main expenditure components through an examination of the revisions to those estimates. It covers the seven largest OECD countries and, as such, updates and extends upon previous OECD analysis on the topic. Overall, the results are broadly similar to the earlier work; that preliminary estimates for output growth have not been statistically biased, although the average size of revisions has been large but smaller than those exhibited by the demand components of GDP.

Les données des comptes nationaux fournissent le résumé statistique disponible le plus complet sur les évolutions des économies nationales. Elles sont d'un grand intérêt pour une large gamme d'utilisateurs d'informations économiques. Ces utilisateurs, qu'ils soient des gouvernements formulant des politiques budgétaires, des banques centrales décidant des politiques monétaires, des entreprises étudiant les choix d'investissement ou des institutions financières prenant des décisions relatives à des choix de portefeuille, ont des besoins qui peuvent différer de diverses manières. Néanmoins, puisque leur intérêt provient généralement de la probabilité qu'ils pourront prendre de meilleures décisions s'ils sont bien informés au sujet des développements économiques, ils s'intéressent tous à l'exactitude des statistiques des comptes nationaux. Ce document examine la fiabilité des statistiques préliminaires des comptes nationaux trimestriels. En particulier, il étudie le comportement à long terme des estimations provisoires de la croissance du PIB et des principales composantes de la demande, en examinant les révisions opérées sur ces estimations. Il couvre les sept principaux pays de l'OCDE et ainsi, met à jour et prolonge les précédentes analyses de l'OCDE sur la question. Dans l'ensemble, les résultats sont d'une manière générale similaires aux précédents travaux, à savoir que les estimations préliminaires de la croissance de la production ne sont pas biaisées statistiquement, bien que l'ampleur moyenne des révisions soit importante mais plus petite que celles affectant les composantes de la demande du PIB.

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The Reliability of Quarterly National Accounts in Seven Major Countries: A User's Perspective*

I. Introduction and main conclusions

1. National accounts data provide the most comprehensive overview available of developments in national economies. They are of great interest to a wide range of users of economic information. These users, which include governments formulating budgetary policies, central banks making monetary policy decisions, businesses considering investment decisions and financial institutions making judgements concerning portfolio allocation, have needs which may differ in various respects. However, since their interest generally stems from the likelihood that they will make better decisions if they are well informed about economic developments, they all have a strong interest in the accuracy of national accounts statistics.

2. For many of these users of economic information, concerns about timeliness make the preliminary national accounts data, which in most OECD countries become available on a quarterly basis, of particular interest. Indeed, it is not unusual for these data to have an immediate impact on financial markets and to influence macroeconomic policy debate.¹ The focus of this paper, therefore, is on the accuracy of preliminary quarterly national accounts statistics. In particular, it considers the longer-term behaviour of the provisional estimates to GDP growth and its main expenditure components through an examination of the revisions to those estimates. It covers the seven largest OECD countries and, as such, updates and extends the analysis conducted in previous OECD work on the topic.²

3. Overall, the results are broadly similar to the findings of previous OECD work:

- Preliminary estimates for output growth have not been statistically biased, but the average size of revisions has been large, in some cases exceeding the average growth rate.
- The picture for revisions to preliminary inflation estimates is broadly similar.
- Revisions to the demand components similarly imply no statistical bias to preliminary estimates, but they are generally larger than those for total GDP growth - especially for exports and imports of goods and services.
- The behaviour of revisions does not suggest that preliminary estimates are getting better or worse over time.

4. The remainder of this paper proceeds as follows. The next section sets out the approach taken in this paper and the criteria for judging the quality of the quarterly national accounts, and the following section summarises the results of the assessment. The final section makes some concluding observations from a user's perspective on the issue of timeliness and accuracy of national accounts data and the prospects for improving the quality of this data.

II. Methodology: judging accuracy of national accounts data

5. This study follows the methodology used by many statistical agencies to assess the quality of national accounts data. It focuses on revisions to the "preliminary" (or the first published) estimates of the quarter-on-quarter growth of real GDP, its main components (private and government consumption, investment, and exports and imports) and their associated price deflators.³ Growth rates, rather than variable levels are examined in order to minimise the impact on the results of conceptual changes in the data and changes in base years used to construct the constant price estimates; and because growth rates are of more direct interest to the main user groups of the statistics. Revisions are defined as the difference between the preliminary estimates (P) of each variable and the "final" estimates (F). Historical data for the preliminary estimates come from the OECD's *Quarterly National Accounts* publication, beginning with issue Number 4, 1979. Historical data for the final estimates are based on those statistics published by the OECD in *Quarterly National Accounts*, Number 2, 1994. National statistical sources and the periods covered by the study are listed in Table 1.⁴

6. The analysis consists of three parts. The first involves the calculation of several summary measures of the size and distribution of revisions and replicates the analysis conducted in previous OECD studies on the topic. The summary measures include: average and relative bias; average and relative dispersion; the standard deviation; and the frequency of positive and negative errors.⁵ These summary measures are reported in detail for GDP and the components of demand in Tables 1a-7a in the Appendix.

7. The second part expands on previous OECD work by evaluating the statistical properties of provisional estimates and revisions in terms of unbiasedness and efficiency. A provisional estimate is considered to be accurate if it is statistically unbiased and efficient in the sense of Muth's (1961) rational expectations framework. Random adjustments to the initial growth rates of GDP and its components can and are expected to occur for any given quarter and as a consequence the revision over any given period may be non-zero. However, abstracting from these random elements, the notion of *unbiasedness* requires that the expected average revision be zero -- so that on balance, initial projections are equivalent to outturns. (In technical terms, the mean revision should not be significantly different from zero.) The notion of forecast *efficiency* assumes that statistical agencies use all of the information that is available to them when constructing the initial estimates. Thus in order for revisions to embody forecast efficiency it follows that they must be unrelated to information available at the time the preliminary estimate is made.

8. The test for both unbiasedness and efficiency used in this analysis is based on the work of Holden and Peel (1990) and elaborated upon by Barrionuevo (1993). An ordinary least squares (OLS) regression of the revision on a constant allows a simple but sufficient test of unbiasedness. The null hypothesis is that the estimated coefficient from such a regression is not significantly different from zero. If it is not, the size of revisions could be systematically reduced by adjusting the preliminary estimates by the constant coefficient. The check of efficiency involves testing the statistical significance of the coefficients from an OLS regression of the revision on the preliminary estimate (the so-called beta test) and from a regression of the current period's revision on the previous period's revision (the so-called rho test).⁶ If the beta and rho tests are jointly passed (*i.e.* if neither beta nor rho is statistically different than zero), the advance

estimates are presumed to be efficient. A failure of either or both tests implies inefficiency and that the variance of revisions could be improved upon. The regression results which these tests involved are reported in Tables 1b-7b in the Appendix.

9. Beta and rho can provide some indication of the nature of the inefficiency of a preliminary indicator and a potential means of adjustment to improve them. Barrionuevo (1993) notes that if beta is zero but rho is not, the variance of revisions could be reduced by adjusting the estimate by rho, since in this case, past errors are being repeated in the present. (In other words, if a projection is widely off the mark, a non-zero rho suggests that some of that error should be brought forward into next period's projection, in the same way an error-correction model accounts for past mistakes.) If on the other hand, beta is different from zero but rho is not, the variance of revisions could be improved upon by adjusting the estimates by beta, since in this case, the revisions contain information that is not being incorporated in the preliminary estimate.

10. The third part of the analysis explores the possibility that the economic cycle and inflation may each have a separate and systematic influence on the behaviour of initial indicators and their subsequent revisions. This is motivated by observations in some countries, that when the initial estimate of growth is high (low), more often than not, subsequent changes are in the downward (upward) direction.⁷ Research carried out by the Central Statistical Office (CSO) in the United Kingdom has similarly uncovered a bias in the preliminary indicators linked to changes in the United Kingdom's rate of inflation (CSO 1985). The experience in the United Kingdom is such that when the rate of inflation is rising quickly, the CSO frequently overstates the initial GDP figures and revises downward its future estimates.

11. The explanatory power of the output gap and/or the rate of inflation (GDP deflator) in determining the size and direction of updates to GDP growth is examined by estimating regression equations. The output gap -- defined here as the difference between the preliminary estimate of quarterly GDP and the trend level, where the trend is based on the final GDP series⁸ -- is used here to define the business cycle, because it explicitly distinguishes between quarters of above- and below-, as well as average- growth. It is also useful as a test of the null hypothesis since at any point in time, policymakers and economic forecasters often have a fairly clear notion of where an economy is operating relative to its trend or potential output. In the event, a tendency for provisional estimates of output to be over-estimated (under-estimated) when the economy is operating above (below) its trend level, should be identified by a negative (positive) correlation between the output-gap variable and revisions.

III. Summary of the main results

1. Accuracy: summary statistics, bias and efficiency

12. Overall, the results obtained in the present analysis, which are summarised in Table 2 for real GDP and its implicit deflator, are in accordance with the findings of previous OECD studies addressing the nature and scope of revisions to the quarterly national accounts of the seven major OECD countries. The preliminary estimates of GDP growth for six of the seven major countries have, on average, understated the final growth figures over the period 1980-94. In the case of Japan, they have been very slightly overstated. These average errors (*i.e.*, the average biases) are

generally small and the preliminary estimates are statistically unbiased (*i.e.*, not statistically different from zero at the 95 per cent level of significance).

13. When judged against the measure of average dispersion (that is, in terms of absolute revisions) the size of the *ex post* adjustments rises appreciably, from a low of 0.29 percentage points (1.2 per cent at an annual rate) for France to a high of 0.80 percentage points (3.2 per cent at an annual rate) for the United Kingdom. These figures are quite substantial in comparison to average growth rates and, in the case of Germany and the United Kingdom, exceed them. Standard deviations, which provide an alternative indication of the size of absolute revisions, are typically larger, ranging from a low of 0.37 per cent for France (1.4 per cent at an annual rate) to as high as 1.36 per cent for the United Kingdom (5.4 per cent at an annual rate).

14. With regard to the components of GDP (see Appendix Tables) average biases are often negative, but they are not statistically significant for any component for any country. However, the preliminary estimates contain wide measurement errors, as reflected in large average dispersions and standard deviations, especially with respect to exports and imports of goods and services. Across the seven countries, the average dispersion for both these components is around 1.6 per cent (or 6.6 per cent at an annual rate) with standard deviations of around 2 per cent (more than 8 per cent at an annual rate), which is 2-3 times larger than those for GDP. If the magnitude of adjustments are compared against final outcomes, *i.e.* in terms of relative dispersion, the largest changes occur to government consumption for six of the seven countries (France being the exception). The measure of relative dispersion for government consumption -- which indicates the size of the revision as a proportion of the final figure -- is typically around unity. This implies that provisional quarterly estimates of the growth of government consumption are, on average, 100 per cent higher or lower than the final figures.

15. For the GDP-based measure of inflation, six out of the seven countries on average, also require upward revisions to the initial quarterly estimates (the exception is Germany, where the average bias is zero), but only for Italy is this bias statistically significant or does it amount to more than 0.12 per cent (around 0.5 per cent at an annual rate). Indicators of the absolute size of revisions, *i.e.* the absolute dispersion and the standard deviation, are similar to those for volumes. For the other price deflators, no general pattern emerges across the group of countries, although implicit prices for exports and imports tend to need the widest margin of adjustment. Except for Italy's government consumption and Canada's investment deflators, preliminary estimates of the component-price deflators are statistically unbiased.

16. Overall, there appears to be little advantage to be gained by making a priori judgements concerning the direction of future revisions to the advanced estimates of output growth and its main components. With very few exceptions, revisions to the initial estimates are statistically unbiased and future adjustments are largely random, so making such judgements could lead to unnecessary errors in assessment with no net benefits. However, since the absolute size of the revisions that can reasonably be expected is fairly large, the range of uncertainty that surrounds the early national accounts data is significant and they must always be interpreted cautiously.

17. In most cases, preliminary national accounts estimates are not efficient. This implies that the variance of revisions is larger than it needs to be and that it might be reduced, perhaps through better interpretation and more effective use of the available information set. The frequency with

which estimates of beta and rho are statistically different from zero suggests that there is unexploited information contained in the data which could be used to smooth the variability of the preliminary figures. Such information -- obtained from estimated equations from the beta- and rho- tests of efficiency -- is used to demonstrate these potential improvements in the case of government consumption. As shown in Table 3, the standard deviation of an adjusted series can be as much as 50 per cent lower than the actual (unadjusted) series.⁹

2. *The stable behaviour of revisions over time*

18. Since the methodology used in this study closely follows that used in previous OECD work (OECD 1979), it allows for some general comparisons to be drawn with the earlier work. However, the findings should not be directly compared, given differences in the way revisions are specifically defined. In the 1979 OECD study, for example, revisions are based on the difference between the initial estimate of the variable in question with the "final" figure obtained one-year later. Here, on the other hand, "final" outturns are derived from the historical series published in the 2nd quarter of 1994. As a consequence, the present study may explore revisions of greater magnitude and variance. It should be noted, however, that to the extent that this is the case the larger revisions are presumably better measures of the accuracy of the preliminary estimates.

19. In comparing the findings of the 1979 study (Table 4) with those reported here, several observations can be made which point to the consistent quality of the quarterly national accounts over a long period of time. First, output growth in the major countries covered in both studies is, on average, slightly under-estimated in most cases, with the size and distribution of revisions falling within a similar order of magnitude in both studies. Second, the largest revisions (and widest variance) continue to occur in the trade statistics. Like the present study, the earlier analysis reported average dispersions to revisions for both exports and imports which are 2-3 times larger than those made to preliminary projections of national income growth. Third, this enquiry has confirmed one of the findings of earlier work, namely that *relative* to final outturns, revisions to government consumption tend to be the largest of the national expenditure components. This would appear to suggest that wide margins of uncertainty about the way governments carry out their own expenditure plans persist.

20. Finally, the sample used in the present study was split into two periods (roughly 1980-86 and 1987-93) and summary statistics compared. (The sample split reflects the simplistic assumption that changes in quality might be visible as statistical methodologies, techniques and information sets improve over time). Across the group of countries and between periods, the performance of preliminary indicators of GDP growth, its components and their associated price deflators was mixed: some remained larger in the later period and while others were reduced. It could not, therefore, be concluded one way or the other by this inquiry if the quality of the quarterly national accounts statistics either improved, deteriorated, or remained the same over the period. A similar conclusion was reached in the two earlier studies.

3. *The influence of the economic cycle*

21. Regression results using revisions to the quarterly growth rate of GDP as the dependent variable and the output gap as the explanatory variable yield no significant relationships for six out of the seven countries under study (Table 5). There appears to be no systematic relationship between the magnitude and direction of revisions and the path of the economy as it moves above or below the trend-determined level of output.

22. Some experimentation with a variation of this relationship, however, does reveal a positive but statistically weak influence (adjusted R^2 of 35 per cent) between revisions and changes in the output gap measure¹⁰ for the United States, Japan and the United Kingdom.¹¹ In the United Kingdom, where the statistical relationship is the strongest and explains 75 per cent of the historical revisions, a small negative relationship with the level of output relative to trend also emerges. In these three countries, increases in the rate of economic growth away from trend result in some tendency for preliminary estimates of quarter-on-quarter GDP growth to be under-estimated, by around 0.2, an 0.4 and 0.9 percentage points, respectively. In other words, when their economies are expanding (or contracting) quickly, the regression results suggest that updates to advanced indicators are more likely to be in the upward (downward) direction.

4. *The influence of inflation*

23. Since many of the historical downward revisions to real output growth have occurred in years in which inflation was high and rising -- for example, in the years after the first oil price shock -- it has been suggested that these movements may be influenced by changes in prices. A relationship of this nature has been identified in previous empirical work undertaken by the Central Statistical Office (CSO) in the United Kingdom, which uncovered a likelihood that advance estimates of growth are overestimated when inflation is high and rising and that they are under-reported when inflation is decelerating (CSO, 1985).

24. Regressions of revisions to quarterly real GDP growth on the rate of inflation (GDP deflator) and on changes in the rate of inflation¹² in the present analysis confirm a statistically significant, but weak relationship in the data for the United States, Germany and Canada. (In the case of both Germany and Canada, the influence of inflation only explains about 10 per cent of the overall revisions.) For the German and Canadian data, increases in the price level appear to be associated with an upward bias in the advanced estimates of output growth, by around 0.4 and 0.2 percentage points respectively. In contrast, for the United States, downward adjustments to provisional figures, of the order of 0.4 percentage points, seem necessary whenever the rate of inflation is accelerating. In the case of the United Kingdom, previous results on the effects of inflation were not corroborated here. This apparent inconsistency may be explained by the different sample periods used -- the CSO's data was drawn from the high-inflation years of the 1970s while the present investigation draws from the comparatively low-inflation years of the 1980 -- and possibly by the changing influence of oil in the UK economy.

IV. Concluding remarks from a user's perspective

25. From the perspective of users whose concerns are largely about economic policy, the foregoing results are disappointing. The analysis of current economic developments and prospects is essential for macroeconomic policy analysis and formulation and also provides an important element of the overall context in which structural policies must be analysed and formulated. Indeed, there are at least two areas in which it is crucial to policymakers in economics and finance ministries and central banks.

- i. Monetary policy decisions must be based on perceptions of how the economy is evolving, what forces are operating on it, and how it will evolve on the basis of alternative monetary policy decisions;
- ii. Large parts of government spending and revenues are tied to the evolution of important macroeconomic variables. It is difficult to see, for example, how a modern budget could sensibly be produced in isolation from a well-defined view of how the economy is evolving and, indeed, a formal set of macroeconomic projections is almost a necessity.

More generally, the analysis of current economic developments and prospects provides a premise for much of the "story telling" which governments must do as they continuously communicate, explain, defend and sell their policies - both macroeconomic and structural - to the general public.

26. The comprehensiveness of national accounts data, which makes them not mere indicators but virtually the definitive statement of how the economic situation has evolved, is almost unique among the various sources of economic information. Where they become available sufficiently early to be of current, rather than historical, interest they provide new information about the economic situation which contributes directly to policy formulation. Where forecasts are required, the latest national accounts data almost invariably serve as the starting point and, indeed, the accuracy of forecasts is highly dependent on their accuracy.¹³ Furthermore they influence business and, especially, financial market behaviour and, more generally, public perceptions about the economy, which in turn affect public debate. They therefore can affect the future course of a wide range of policies. Consequently, timely and accurate national accounts data would be highly desirable.

27. The contribution that accurate national accounts data can make to an understanding of the economic situation goes beyond the information contained in the total GDP figures. In particular, the expenditure based accounting framework which provides a decomposition of GDP into the main demand components lends itself well to examining developments in different parts of the economy (*i.e.*, households, business, government, the foreign sector) and to analysing the forces operating on the economy. Good data on demand components from expenditure based national accounts estimates are therefore very helpful both for policy formulation and for communicating public policy decisions. While the income and, to a lesser extent, production based approaches to measuring GDP also produce useful decompositions, for many users these are of more limited value than the main demand components which emerge from the expenditure approach.

28. Unfortunately, while the lack of bias in preliminary estimates is reassuring, the large average dispersions and standard deviations of the revisions imply that the signal-to-noise ratio in these data is lower than desirable. The poor quality of the demand component estimates is a serious defect. In addition, there are some grounds for believing that the signal-to-noise ratio in the preliminary data in a number of countries is possibly even lower than the results reported above would suggest. The comparatively large size of revisions which typically occur to national accounts data in the United Kingdom is somewhat surprising in view of the comparative high regard with which most users regard British statistics. One possible explanation for this is that the CSO is doing something seriously wrong and that it has much to learn from other statistical agencies. An alternative explanation, to which considerable weight must be attached, is that by investing more time and effort into revising the accounts the CSO eventually, albeit over a period of several years, provides "more accurate" statistics than other statistical agencies. To the extent that this is the case, the apparently greater accuracy of provisional data elsewhere is a mirage which just reflects less accurate final data - indeed, revisions could be reduced to zero by the simple device of never going beyond the preliminary estimates.

29. An important feature affecting the usefulness of national accounts data to economic policy makers and forecasters is its timeliness. The release dates for the quarterly national accounts are given in Table 1. The United States' statistical agency is the quickest in publishing provisional figures just four weeks after quarter's-end, while Italian statisticians require fourteen. Agencies in the other five countries take on average, 8-10 weeks to release initial estimates. The most notable difference among countries with regards to timeliness is the time taken by France, Italy and the United Kingdom in publishing the "final" quarterly estimates for a given year. For example, for 1993, France and the United Kingdom publish "final" estimates in 1995, while in Italy, they do not appear until 1996. Meanwhile, the other four major countries succeed in "finalising" the quarterly figures in only 6-9 months. These "final" revisions are then, of course, often revised sporadically in later years as further new information becomes available.

30. For the purposes of contributing to the understanding of the current economic situation and prospects, most of these provisional release dates are near the outer limit of what is useful, particularly in the Italian case. Since the national accounts variables of interest are flows, the growth rate for any particular quarter roughly measures the middle of the quarter in comparison with the middle of the previous quarter. Thus, a second quarter growth rate roughly compares the position of the economy in mid-May with its position in mid-February, a period whose middle was the end of March. If the initial estimate becomes available in September, *i.e.*, 9-10 weeks after the end of the second quarter, it is already rather dated. For many purposes, notably monetary policy decision making, it would have to be discounted in favour of more recent information, however sketchy, even if its accuracy were completely reliable. Thus while holding off on releasing data until a later stage in the information collection process could reduce or even eliminate the need for future revisions, and would have the benefit of reducing the extent to which misleading information is sometimes placed in the public domain, the deterioration in timeliness could negate their usefulness in terms of providing information about the current economic situation altogether.

31. Clearly, good national accounts data - especially where they are expenditure based - are highly desirable, and improvements would be welcome. However, they are always supplemented by other sources of information - financial market developments, less comprehensive data

covering areas such as unemployment and trade, survey data, anecdotal information, *etc.* -- and users of any type of data must always be aware of their limitations and discount them accordingly. Furthermore, if national accounts data did not exist central banks would still conduct monetary policy, finance ministries would still prepare budgets and governments would still have to tell a story about the economic situation and defend their policies against the background of current economic developments and prospects. The fact they are costly to produce means that improving their quality will involve trade-offs, and these trade-offs must be considered carefully.

32. The above considerations suggest that posing the question of trade-offs simply in terms of timeliness versus accuracy is not helpful. The value of more timely national accounts data will be limited if they are at the expense of accuracy, while users already have the alternative of waiting for improved data to become available if timeliness is not a major concern. The practical issues are whether there is scope for improvements in either timeliness or accuracy without sacrificing the other, or in both at the same time, and whether the extent of such improvements would justify the costs. In the current budgetary climate few resource increases are likely to be forthcoming for the purpose of improving data collection. If more resources are to be devoted to improving national accounts data, they will largely have to be drawn from the production of other types of statistics. The key trade-offs, therefore, involve the improvements that could alternatively be made to other types of statistics or the saving which could be made by dropping statistics that are currently produced but whose usefulness is marginal. This in turn points to the need to evaluate the scope for improving the quality of national accounts data in the context of a broader prioritisation and cost evaluation of all statistical production activities.

Table 1. National statistical agencies: data coverage and release dates (a)

Country	Period (number of observations)	Source	Approximate number of weeks from end of quarter to publication of preliminary estimates	Usual date of publication of final quarterly estimates for year n
United States	80.1 to 93.4 (56)	<i>Survey of Current Business</i> , US Department of Commerce, Washington	4	July, n+1
Japan	80.2 to 93.4 (55)	Economic Planning Agency, data published in <i>Economic Statistics Monthly</i> , Statistics Department of The Bank of Japan, Tokyo	10	December, n(b)
Germany (Western)	80.1 to 93.4 (56)	<i>Volkswirtschaftliche Gesamtrechnungen</i> , Statistisches Bundesamt, Wiesbaden	9	September, n+1
France	80.1 to 93.4 (56)	Data provided directly by the Institut National de la Statistique et des Études Économiques (INSEE), Paris (d)	10(c)	April, n+2
Italy	87.1 to 93.4 (28)	<i>Bolletino Mensile di Statistica and Notizario</i> , Istituto Centrale di Statistica (ISTAT), Rome	14	July, n+3
United Kingdom	82.1 to 93.4 (48)	<i>Economic Trends</i> , Central Statistical Office, London	8(c)	September, n+2
Canada	80.1 to 93.4 (56)	<i>National Income and Expenditure Accounts</i> , Statistics Canada, Ottawa	9	June, n+1

a) The data are expenditure-based national accounts which are taken from OECD's publication, *Quarterly National Accounts* beginning with volume Number 4, 1979 and ending with volume Number 2, 1994. The data published by the OECD come directly from the corresponding quarter of the national sources listed in the table and have not been transformed or adjusted in any way by the OECD.

b) For the four quarters ending in March of year n.

c) France and the United Kingdom report partial sets of estimates before they release the fuller sets of estimates consisting of expenditure based accounts in volume and in current price terms which are the subject of this study. In France, estimates of the main demand components are reported around seven weeks after the end of the quarter in volume terms only. In the United Kingdom an estimate of the output based measure of GDP and some sectoral production estimates are released around four weeks after the end of the quarter, but these do not contain a break-down from the expenditure side or price estimates.

d) The data are published by INSEE in *Informations Rapides*.

Table 2. Summary of revisions analysis for the major seven countries¹

Quarter-to-quarter percentage changes

	U.S.	Japan	Germany	France	Italy	UK	Canada
<u>Real GDP</u>							
Average growth rate	0.55	0.85	0.48	0.45	0.45	0.58	0.57
Average bias ²	-0.04	0.01	-0.05	-0.05	-0.10	-0.18	-0.08
Average dispersion ³	0.42	0.50	0.60	0.29	0.38	0.80	0.39
Standard deviation ⁴	0.60	0.67	0.75	0.37	0.48	1.36	0.51
Unbiasedness ⁵							
Efficiency (beta) ⁶	*	*	*		*	*	
Efficiency (rho) ⁷		*					
<u>GDP deflator</u>							
Average growth rate	1.10	0.45	0.79	1.36	1.47	1.29	1.07
Average bias	-0.03	-0.09	0.00	-0.04	-0.31	-0.12	-0.03
Average dispersion	0.29	0.31	0.49	0.27	0.47	0.74	0.45
Standard deviation	0.47	0.39	0.66	0.34	0.51	1.11	0.62
Unbiasedness					*		
Efficiency (beta)	*	*	*		*	*	*
Efficiency (rho)							

Notes:

1. Detailed summary statistics for each country and for each of the major components of GDP are presented in the Appendix tables. Data for the United States, Germany (Western), France and Canada run from Q1/1980 to Q4/1993; from Q2/1980 to Q4/1993 for Japan; from Q1/1982 to Q4/1993 for the UK; and from Q1/1987 to Q4/1993 for Italy.
2. The average bias is defined as $1/n\sum(P-F)$; where P is the preliminary and F the final estimate.
3. The average dispersion is defined as $1/n\sum|P-F|$.
4. The standard deviation is defined as the square root of $1/n\sum(d-d^*)^2$ where $d=P-F$ and d^* is the sample mean.
5. The property of unbiasedness is checked for by an OLS regression of the revision on a constant. A * indicates that the estimated coefficient is statistically different from zero at the 95 per cent level of significant.
6. The beta-test for the property of efficiency involves an OLS regression of the revision on the preliminary estimate.
7. The rho-test for the property of the efficiency involves an OLS regression of the current periods revision on the previous periods revision.

Table 3. Actual compared to adjusted revisions to real government consumption¹

Quarter-to-quarter percentage changes

	U.S.	Japan	Germany	France	Italy	UK	Canada
<u>Actual revisions</u>							
Average growth rate	0.55	0.62	0.29	0.55	0.36	0.32	0.54
Average bias ²	-0.13	0.02	-0.02	-0.09	-0.02	-0.05	-0.24
Relative bias	-0.23	0.03	-0.09	-0.17	-0.06	-0.15	-0.44
Average dispersion	0.98	0.92	0.95	0.40	0.31	0.89	0.79
Relative dispersion	1.17	0.84	0.93	0.68	0.82	1.15	0.82
Standard deviation	1.42	1.46	1.34	0.54	0.42	1.09	1.05
<u>Adjusted revisions</u>							
Average bias	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Relative bias	0.00	0.00	0.00	0.01	0.01	0.00	0.00
Average dispersion	0.64	0.63	0.79	0.24	0.23	0.65	0.80
Relative dispersion	0.76	0.58	0.77	0.40	0.59	0.83	0.83
Standard deviation	0.78	0.96	1.02	0.29	0.29	0.83	0.99

Notes:

1. The adjusted revisions are obtained by using ex-post information about the nature of inefficiencies in the actual revisions indicated by the beta-and rho-tests.
2. The average bias, dispersion and standard deviation are defined in Table 2. The relative bias is defined as $\Sigma(P-F)/\Sigma F$ and the relative dispersion as $\Sigma|P-F|/\Sigma|F|$.

Table 4. Summary statistics of revisions from the 1979 OECD study*

	Bias		Dispersion		Standard Deviation
	Average	Relative	Average	Relative	
US					
GNP	-0.02	-0.03	0.23	0.21	0.34
Private consumption	0.02	0.03	0.27	0.26	0.37
Government consumption	0.14	0.19	0.47	0.40	0.56
Gross fixed cap. formation	0.09	0.26	0.86	0.38	1.04
Exports	0.03	-0.02	1.35	0.37	1.87
Imports	0.29	0.20	1.11	0.27	1.48
Japan					
GNP	-0.22	-0.17	0.73	0.42	0.88
Private consumption	-0.27	-0.18	0.68	0.33	0.87
Government consumption	-0.40	-0.25	1.25	0.78	1.51
Gross fixed cap. formation	0.29	0.39	0.90	0.32	0.97
Exports	-0.10	-0.04	1.27	0.40	1.53
Imports	0.07	0.05	1.20	0.39	1.49
Germany					
GNP	-0.12	-0.29	0.56	0.42	0.78
Private consumption	-0.18	-0.29	0.60	0.61	0.69
Government consumption	-0.15	-0.14	1.06	0.81	1.33
Gross fixed cap. formation	-0.22	5.07	2.20	0.82	2.84
Exports	0.29	0.19	1.23	0.41	1.62
Imports	-0.20	-0.13	0.69	0.28	1.03
UK					
GNP	-0.01	-0.02	0.77	0.52	1.00
Private consumption	-0.10	-0.19	0.54	0.38	0.71
Government consumption	-0.01	-0.01	0.78	0.73	1.01
Gross fixed cap. formation	-0.15	-0.44	0.95	0.39	1.14
Exports	-0.15	-0.12	0.71	0.17	0.94
Imports	-0.01	-0.01	0.73	0.26	1.15
Canada					
GNP	-0.04	-0.04	0.59	0.52	0.79
Private consumption	--	--	0.39	0.27	0.52
Government consumption	0.07	0.05	1.62	0.71	2.13
Gross fixed cap. formation	0.07	0.09	1.29	0.60	1.67
Exports	-0.06	-0.04	1.23	0.41	1.67
Imports	0.27	0.13	1.00	0.32	1.33

Note: The symbol -- indicates less than 0.01.

* Results obtained from Table 2 of, *Quarterly National Accounts: A Report on Sources and Methods in OECD Countries*, OECD, 1979, Paris.

Table 5. **The effect of the business cycle and inflation on revisions**

Dependent variable is the revision to the quarterly growth rate of real GDP

Variable	Constant	GAP	DGAP	PGDP	DPGDP	S.E.E.	Adjusted R ²	D-W
United States Q1 1980 - Q4 1993	-0.11 (1.15)	0.04 (1.27)				0.60	0.01	2.18
	-0.03 (0.49)		0.17* (2.26)		-0.43* (4.26)	0.49	0.34	1.69
Japan Q2 1980 - Q4 1993	0.05 (0.52)	0.06 (1.32)				0.66	0.01	2.59
	0.04 (0.61)		0.44* (5.48)			0.53	0.35	2.24
Germany Q1 1980 - Q4 1993	-0.06 (0.38)	0.00 (0.09)				0.76	0.00	2.20
	0.23 (1.58)			-0.35* (2.56)		0.72	0.09	2.09
France Q1 1980 - Q4 1993	-0.06 (1.12)	0.02 (0.73)				0.37	0.01	2.19
Italy Q1 1987 - Q4 1993	-0.09 (1.01)	0.08 (1.12)				0.47	0.01	1.45
United Kingdom Q1 1982 - Q4 1993	-0.27 (1.00)	0.02 (0.49)				1.37	0.01	1.96
	0.24 (1.71)	-0.05* (2.35)	0.86* (11.88)			0.68	0.75	1.05
Canada Q1 1980 - Q4 1993	-0.09 (1.29)	-0.01 (0.55)				0.51	0.01	2.18
	0.13 (1.33)			-0.20* (2.94)		0.48	0.12	2.21

Notes:

* denotes 95 per cent level of significance.

Absolute values of t-statistics in parentheses.

The influence of the business cycle and inflation on revisions is tested using ordinary least squares. The test involves estimating the relationship, first between revisions to the quarterly growth rate of real GDP and the output gap (plus a constant); and second to add sequentially the separate influence of changes in the output gap (first difference of the gap variable), inflation and changes in the rate of inflation (first difference of the inflation variable). Reported for every country are the outcomes of the first stage of the analysis and the "best-fitting" results of the second stage.

Variable definitions:

GAP = Output gap (per cent): defined as the difference between the preliminary estimate of quarterly and trend GDP relative to trend GDP. Trend GDP is based on the final estimates and calculated using a time trend.

DGAP = First difference of the GAP variable.

PGDP = Rate of inflation (GDP deflator).

DPGDP = First difference of the PGDP variable.

NOTES

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1. The availability of other sources of information about economic developments provides considerable protection from misleading information when national accounts are inaccurate, but there have on occasion been instances when better data would have contributed to a far better appreciation by policy makers and the general public of what was happening in the economy. One notable case in point was the United Kingdom in the mid-1980's, when the national accounts frequently suggested more moderate expansion than was actually taking place. The *OECD Economic Outlook*, which was probably representative of commentary on the economic situation, noted at the time:

"The recovery has now lasted five years and looks set to continue...even though the pace of recovery seems to have slowed " (May 1986).

"The slowdown in growth since mid-1985 has lasted longer than expected. Over the past year or so the economy has been expanding at only two-thirds of the rate achieved on average in the first four years of the recovery" (December 1986).

"The United Kingdom is enjoying continued expansion....The growth of activity is projected to decelerate in the period ahead. In 1987, however, real GDP should exceed 3 per cent" (June 1987).

On the basis of the information available at the time these were plausible assessments, but we now know that growth during this period was far stronger than it appeared to be at the time (see Table below) and that the economy was on its way to becoming seriously overheated. There were many influences on the evolution of macroeconomic policy during this period and the years that followed and mistakes that were made cannot simply be attributed to data problems. But a better understanding of how the economy was evolving would have provided a better basis for decision-making and more accurate national accounts would have contributed significantly in this regard.

Revisions to Output Growth Estimates: United Kingdom
(Percentage increase in real GDP over previous year)

	Early estimate ¹	Final estimate ²
1985	3.2	3.8
1986	2.7	4.3
1987	4.5	4.8

1. As reported in *OECD Economic Outlook* in the following May or June.

2. As reported in *OECD Economic Outlook* 59, June 1996.

Another instance where inaccurate national accounts data probably contributed to misguided public perceptions about the evolution of the economy was in the United States during 1992. Again taking the commentary of the *OECD Economic Outlook* as representative, the picture toward the end of the year appeared to be as follows:

"The recovery of activity since the 1990-91 recession continues to be rather weak....real growth may pick up from the 1½ - 2 per cent range which has prevailed since early 1991." (December 1992).

We now know that the economy was expanding substantially more rapidly than this: by more than 3½ per cent during the course of 1992. It is not clear that the perceptions of weakness that prevailed during 1992 led directly to any policy errors, but there is little doubt that they had political implications in an election year and that they influenced post-election debates about how fiscal policy should proceed.

2. See, for example, OECD (1979) which offers a survey of past literature across several OECD countries. More recent analysis for the United Kingdom can be found in CSO (1994).
3. Inventory adjustments are omitted from the analysis for two reasons: 1) given the focus on growth rates, the inherent instability of changes in stocks would make their interpretation difficult; and 2) it was not possible in any case to construct a consistent constant price series for the inventory variable.
4. Growth rates are derived from the corresponding levels of the seasonally-adjusted constant price series for each quarter. The series for the United Kingdom begins in Q2/1982 to remove the possible bias in the data resulting from the civil service strike in 1981, while the series for Italy is substantially shorter than that for the other countries due to gaps in data for the earlier years.
5. The average bias is defined as $1/n\Sigma(P-F)$; relative bias as $\Sigma(P-F)/\Sigma F$; average dispersion as $1/n\Sigma|P-F|$; relative dispersion as $\Sigma|P-F|/\Sigma|F|$; and standard deviation as the square root of $1/n\Sigma(d-d^*)^2$, where $d = P-F$ and d^* is the sample mean.
6. The beta test is conducted by an OLS regression of the revision on a constant and the preliminary estimate, while the rho test involves a regression of the current period's revision on a constant and the previous period's revisions.
7. There may be some bias here, since only studies carried out by the Central Statistical Office of the United Kingdom have verified such a relationship empirically. Studies done for other

countries have based these types of conclusions on casual observations of particular quarters with high (or low) growth.

8. The output gap is expressed as a percentage of trend GDP, where trend GDP is estimated from a time trend through the final series of the GDP figures for each of the seven countries.
9. The nature of the adjustment is to use the ex post information provided by the beta and rho-tests. The government consumption variable is transformed by adjusting the original series by the estimated coefficients from the OLS regression equations explained in footnote 6 above.
10. Changes in the output gap refer specifically to the first difference of the output-gap variable.
11. The bias uncovered as a result of the phase of the cycle for the United Kingdom data is consistent with previous work carried out by the United Kingdom, Central Statistical Office (CSO, 1985). In this work, however, the CSO did not examine the relationship between revisions and the rate of change of quarterly growth.
12. The first difference of the inflation rate.
13. A meeting among business and trade union experts on "Improvement of Economic Forecasts" concluded that data inaccuracies were a significant cause of forecasting problems. The rapporteur noted: "It was felt that an accurate up-to-date picture of what was happening in the economy would have helped substantially in making forecasts in a number of countries." (Mansley, 1995). While a recent analysis by the OECD Secretariat on forecasting accuracy employed a slightly different methodology and covered a different period than does the Mansley study, its results would suggest that forecasting accuracy compares reasonably well with that of the national accounts data that provide the starting point for these forecasts. See OECD (1993), especially, the summary statistics reported in Tables 16-19.

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NOTES TO APPENDIX TABLES

In the following Appendix Tables, summary statistics in Tables 1a to 7a are defined as, where P = preliminary estimate and F= final estimate:

Average bias = $1/n\sum(P-F)$

Relative bias = $\sum(P-F)/\sum F$

Average dispersion = $1/n\sum|P-F|$

Relative dispersion = $\sum|P-F|/\sum|F|$

Standard deviation = the square root of $1/n\sum(d-d^*)^2$, where $d = P-F$ and d^* is the sample mean.

In Tables 1b through 7b, the statistical properties of revisions are analysed by the following tests:

Unbiasedness: An ordinary least squares regression (OLS) of revisions on a constant. The reported statistics are the estimated coefficients from that regression.

Efficiency (beta): The beta-test for efficiency involves an OLS regression of revisions on the preliminary estimate. The reported statistics are the estimated coefficients from that regression.

Efficiency (rho): The rho-test for efficiency involves an OLS regression of current period revisions on last period's revisions. The reported statistics are the estimated coefficients from that regression.

Efficiency requires accepting the null hypothesis that both beta and rho are not significantly different from zero. A * indicates statistical significance at the 95 per cent level.

Appendix Table 1a. **United States**

Period: Q1 1980 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Average growth rate	0.63	0.55	0.51	1.04	1.50	0.55
Average bias	0.04	-0.13	0.03	-0.18	0.20	-0.04
Relative bias	0.07	-0.23	0.05	-0.18	0.13	-0.08
Average dispersion	0.44	0.98	1.27	1.37	1.81	0.42
Relative dispersion	0.56	1.17	0.65	0.62	0.72	0.49
Standard deviation	0.60	1.42	1.73	1.73	2.57	0.60
<i>Tendency</i>						
P > F	28	24	27	24	26	24
P = F	1	1	2	2	1	2
P < F	27	31	27	30	29	30
Implicit prices						
Average growth rate	1.16	1.09	0.70	0.66	0.41	1.10
Average bias	-0.08	0.09	-0.12	-0.68	-0.61	-0.03
Relative bias	-0.07	0.08	-0.17	-1.03	-1.48	-0.03
Average dispersion	0.24	0.56	0.56	0.98	1.24	0.29
Relative dispersion	0.20	0.50	0.73	1.25	0.85	0.26
Standard deviation	0.33	0.80	0.79	2.60	2.39	0.47
<i>Tendency</i>						
P > F	16	28	21	22	23	22
P = F	2	0	0	0	0	1
P < F	38	28	35	34	33	33

Appendix Table 1b. **Statistical properties of revisions: United States**

Period: Q1 1980 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Unbiasedness	0.04 (0.54)	-0.13 (0.67)	0.03 (0.12)	-0.18 (0.80)	0.20 (0.59)	-0.04 (0.53)
Efficiency (beta)	0.43* (7.40)	0.72* (11.06)	0.22* (2.63)	0.28* (3.56)	0.43* (5.23)	0.25* (3.02)
Efficiency (rho)	0.11 (0.84)	0.28* (2.13)	0.02 (0.13)	0.14 (1.02)	0.48* (3.99)	0.08 (0.59)
Prices						
Unbiasedness	-0.08 (1.77)	0.09 (0.84)	-0.12 (1.10)	-0.68 (1.96)	-0.61 (1.91)	-0.03 (0.52)
Efficiency (beta)	0.28* (4.90)	0.57* (7.32)	0.33* (3.00)	0.91* (21.05)	0.63* (9.69)	0.37* (4.87)
Efficiency (rho)	-0.10 (0.75)	0.23 (1.77)	0.07 (0.53)	-0.01 (0.08)	0.00 (0.02)	-0.08 (0.59)

Appendix Table 2a. **Japan**

Period: Q2 1980 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Average growth rate	0.76	0.62	1.01	1.59	1.32	0.85
Average bias	-0.06	0.02	0.07	-0.12	-0.02	0.01
Relative bias	-0.08	0.03	0.07	-0.08	-0.02	0.01
Average dispersion	0.42	0.92	0.76	1.65	1.34	0.50
Relative dispersion	0.48	0.84	0.54	0.70	0.51	0.51
Standard deviation	0.53	1.46	1.05	2.26	1.81	0.67
<i>Tendency</i>						
P > F	24	26	32	31	24	28
P = F	2	2	1	1	1	2
P < F	29	27	22	23	30	25
Implicit prices						
Average growth rate	0.49	0.66	0.17	-0.49	-0.88	0.45
Average bias	0.01	-0.04	-0.15	-0.11	-0.21	-0.09
Relative bias	0.01	-0.07	-0.85	0.22	0.23	-0.21
Average dispersion	0.19	1.47	0.48	0.92	1.55	0.31
Relative dispersion	0.34	1.19	1.24	0.58	0.55	0.63
Standard deviation	0.23	2.14	0.86	1.22	2.20	0.39
<i>Tendency</i>						
P > F	25	25	18	26	22	23
P = F	3	2	2	1	1	2
P < F	27	28	35	28	32	30

Appendix Table 2b. **Statistical properties of revisions: Japan**

Period: Q2 1980 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Unbiasedness	-0.06 (0.89)	0.02 (0.09)	0.07 (0.51)	-0.12 (0.39)	-0.02 (0.08)	0.01 (0.13)
Efficiency (beta)	0.23* (2.61)	0.43* (8.35)	0.33* (5.18)	0.46* (7.59)	0.23* (3.76)	0.42* (5.24)
Efficiency (rho)	0.27* (2.06)	0.32* (2.44)	-0.00 (0.03)	0.45* (3.72)	0.12 (0.88)	0.35* (2.74)
Prices						
Unbiasedness	0.01 (0.19)	-0.04 (0.15)	-0.15 (1.26)	-0.11 (0.67)	-0.21 (0.69)	-0.09 (1.77)
Efficiency (beta)	0.21* (4.53)	0.63* (12.81)	0.74* (11.29)	0.29* (5.36)	0.29* (6.21)	0.33* (3.70)
Efficiency (rho)	0.14 (0.99)	0.39* (3.07)	0.06 (0.41)	0.19 (1.40)	0.22 (1.64)	0.17 (1.27)

Appendix Table 3a. **Western Germany**

Period: Q1 1980 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Average growth rate	0.50	0.29	0.22	1.31	0.93	0.48
Average bias	-0.18	-0.02	0.35	-0.21	0.11	-0.05
Relative bias	-0.37	-0.09	1.58	-0.16	0.12	-0.10
Average dispersion	0.82	0.95	1.19	1.10	1.19	0.60
Relative dispersion	0.88	0.93	0.58	0.45	0.59	0.62
Standard deviation	1.39	1.34	1.62	1.60	1.50	0.75
<i>Tendency</i>						
P > F	21	23	31	27	30	21
P = F	0	0	0	0	1	0
P < F	35	33	25	28	25	35
Implicit prices						
Average growth rate	0.75	0.85	0.80	0.52	0.38	0.79
Average bias	-0.06	0.02	-0.15	0.20	-0.11	0.00
Relative bias	-0.08	0.02	-0.19	0.38	-0.29	0.00
Average dispersion	0.77	1.43	1.26	0.88	1.02	0.49
Relative dispersion	0.97	1.36	1.55	1.28	0.67	0.61
Standard deviation	1.29	2.40	1.84	1.51	1.33	0.66
<i>Tendency</i>						
P > F	26	27	24	29	22	28
P = F	0	0	0	1	0	0
P < F	30	29	32	26	34	28

Appendix Table 3b. **Statistical properties of revisions: Western Germany**

Period: Q1 1980 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Unbiasedness	-0.18 (0.99)	-0.02 (0.14)	0.35 (1.61)	-0.21 (0.96)	0.11 (0.56)	-0.05 (0.48)
Efficiency (beta)	0.68* (6.82)	0.55* (6.22)	0.29* (5.28)	0.20* (3.02)	0.19* (2.86)	0.22* (2.44)
Efficiency (rho)	0.12 (0.93)	0.23 (1.73)	0.24 (1.88)	0.02 (0.18)	0.15 (1.11)	0.14 (1.04)
Prices						
Unbiasedness	-0.06 (0.35)	0.02 (0.06)	-0.15 (0.62)	0.20 (0.98)	-0.11 (0.62)	0.00 (0.02)
Efficiency (beta)	0.85* (13.47)	0.80* (12.29)	1.00* (16.81)	0.84* (16.43)	0.32* (4.79)	0.70* (8.25)
Efficiency (rho)	0.19 (1.40)	0.02 (0.16)	0.35* (2.99)	0.09 (0.69)	0.21 (1.60)	0.09 (0.64)

Appendix Table 4a. **France**

Period: Q1 1980 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Average growth rate	0.54	0.55	0.25	0.95	0.80	0.45
Average bias	-0.08	-0.09	-0.12	-0.41	-0.13	-0.05
Relative bias	-0.14	-0.17	-0.47	-0.43	-0.16	-0.10
Average dispersion	0.37	0.40	0.86	1.50	1.44	0.29
Relative dispersion	0.56	0.68	0.77	0.83	0.63	0.48
Standard deviation	0.52	0.54	1.06	1.89	1.91	0.37
<i>Tendency</i>						
P > F	24	23	27	22	28	27
P = F	1	1	1	0	0	1
P < F	31	32	28	34	28	28
Implicit prices						
Average growth rate	1.38	1.43	1.23	1.01	0.96	1.36
Average bias	0.04	-0.07	-0.13	0.10	-0.15	-0.04
Relative bias	0.03	-0.05	-0.11	0.10	-0.16	-0.03
Average dispersion	0.28	0.57	0.65	0.78	0.96	0.27
Relative dispersion	0.21	0.35	0.53	0.53	0.45	0.20
Standard deviation	0.53	0.78	0.91	1.02	1.20	0.34
<i>Tendency</i>						
P > F	30	27	24	27	26	24
P = F	0	0	0	0	0	1
P < F	26	29	32	29	30	31

Appendix Table 4b. **Statistical properties of revisions: France**

Period: Q1 1980 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Unbiasedness	-0.80 (1.12)	-0.09 (1.32)	-0.12 (0.84)	-0.41 (1.61)	-0.13 (0.49)	-0.05 (0.95)
Efficiency (beta)	0.41* (4.36)	0.72* (9.72)	0.26* (2.75)	0.46* (6.51)	0.30* (3.75)	0.16 (1.72)
Efficiency (rho)	0.47* (3.86)	-0.31* (2.42)	0.18 (1.34)	0.15 (1.08)	0.21 (1.56)	0.10 (0.77)
Prices						
Unbiasedness	0.04 (0.59)	-0.07 (0.66)	-0.13 (1.09)	0.10 (0.72)	-0.15 (0.94)	-0.04 (0.89)
Efficiency (beta)	0.17* (2.76)	0.19* (3.17)	0.43* (5.06)	0.24* (3.21)	0.13* (2.37)	0.06 (1.40)
Efficiency (rho)	-0.02 (0.17)	-0.25* (2.15)	-0.03 (0.26)	0.16 (1.16)	0.21 (1.69)	0.04 (0.28)

Appendix Table 5a. **Italy**

Period: Q1 1987 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Average growth rate	0.54	0.36	0.16	1.57	1.08	0.45
Average bias	0.00	-0.02	-0.18	-0.23	-0.23	-0.10
Relative bias	-0.01	-0.06	-1.14	-0.15	-0.21	-0.22
Average dispersion	0.38	0.31	0.81	1.55	1.20	0.38
Relative dispersion	0.49	0.82	0.49	0.54	0.56	0.61
Standard deviation	0.50	0.42	0.99	2.31	1.63	0.48
<i>Tendency</i>						
P > F	11	10	10	14	9	10
P = F	1	2	2	1	1	1
P < F	10	16	16	13	18	17
Implicit prices						
Average growth rate	1.41	1.89	1.21	1.16	1.17	1.47
Average bias	-0.12	-1.05	0.20	0.08	0.07	-0.31
Relative bias	-0.08	-0.55	0.17	0.07	0.06	-0.21
Average dispersion	0.27	1.32	0.59	0.74	0.85	0.47
Relative dispersion	0.19	0.67	0.49	0.50	0.44	0.32
Standard deviation	0.42	1.34	1.12	1.14	1.11	0.51
<i>Tendency</i>						
P > F	10	5	14	14	15	7
P = F	2	1	1	1	1	1
P < F	16	22	13	13	12	20

Appendix Table 5b. **Statistical properties of revisions: Italy**

Period: Q1 1987 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Unbiasedness	-0.00 (0.04)	-0.02 (0.29)	-0.18 (0.96)	-0.23 (0.53)	-0.23 (0.74)	-0.10 (1.09)
Efficiency (beta)	0.23 (1.24)	0.98* (5.22)	-0.17 (1.39)	0.31* (4.34)	0.28* (2.80)	0.35* (2.15)
Efficiency (rho)	-0.31 (1.65)	-0.08 (0.41)	-0.16 (0.85)	0.38* (2.06)	0.04 (0.22)	-0.25 (1.35)
Prices						
Unbiasedness	-0.12 (1.48)	-1.05* (4.14)	0.20 (0.95)	0.08 (0.39)	0.07 (0.35)	-0.31* (3.21)
Efficiency (beta)	0.86* (7.97)	0.33* (3.60)	0.83* (9.72)	0.37* (4.44)	0.21* (3.04)	0.41* (3.02)
Efficiency (rho)	-0.49* (2.80)	-0.32 (1.69)	-0.05 (0.26)	-0.18 (0.93)	-0.12 (0.62)	0.03 (0.16)

Appendix Table 6a. **United Kingdom**

Period: Q1 1982 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Average growth rate	0.76	0.32	0.89	0.85	1.26	0.58
Average bias	-0.14	-0.05	-0.79	-0.07	-0.06	-0.18
Relative bias	-0.18	-0.15	-0.88	-0.08	-0.05	-0.31
Average dispersion	0.62	0.89	1.97	1.83	1.83	0.80
Relative dispersion	0.65	1.15	0.80	0.99	0.74	1.02
Standard deviation	0.80	1.09	2.66	2.57	2.79	1.36
<i>Tendency</i>						
P > F	24	27	23	21	26	16
P = F	0	0	0	0	0	1
P < F	24	21	25	27	22	31
Implicit prices						
Average growth rate	1.25	1.55	0.86	0.90	0.77	1.29
Average bias	-0.01	-0.19	-0.15	-0.05	-0.09	-0.12
Relative bias	-0.01	-0.12	-0.17	-0.06	-0.12	-0.09
Average dispersion	0.31	0.83	0.84	0.97	1.54	0.74
Relative dispersion	0.25	0.52	0.73	0.53	0.68	0.58
Standard deviation	0.41	1.00	1.15	1.41	2.28	1.11
<i>Tendency</i>						
P > F	25	16	24	23	22	25
P = F	1	1	0	0	0	0
P < F	22	31	24	25	26	23

Appendix Table 6b. **Statistical properties of revisions: United Kingdom**

Period: Q1 1982 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Unbiasedness	-0.14 (1.21)	-0.05 (0.30)	-0.79 (2.05)	-0.07 (0.18)	-0.06 (0.14)	-0.18 (0.91)
Efficiency (beta)	0.39* (3.22)	0.74* (4.36)	0.35* (3.02)	0.63* (6.18)	0.55* (4.63)	0.85* (10.84)
Efficiency (rho)	0.03 (0.22)	0.36* (2.72)	0.34* (2.61)	0.36* (2.61)	0.33* (2.34)	-0.01 (0.04)
Prices						
Unbiasedness	-0.01 (0.17)	-0.19 (1.34)	-0.15 (0.89)	-0.05 (0.24)	-0.09 (0.28)	-0.12 (0.76)
Efficiency (beta)	0.36* (5.10)	0.53* (6.01)	0.53* (4.37)	0.08 (0.80)	0.26* (2.03)	0.86* (9.73)
Efficiency (rho)	-0.02 (0.16)	0.23 (1.71)	0.24 (1.65)	0.29* (2.00)	0.34* (2.45)	0.05 (0.31)

Appendix Table 7a. **Canada**

Period: Q1 1980 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Average growth rate	0.59	0.54	0.82	1.35	1.45	0.57
Average bias	-0.03	-0.24	-0.36	-0.33	-0.38	-0.08
Relative bias	-0.06	-0.44	-0.44	-0.24	-0.26	-0.15
Average dispersion	0.35	0.79	1.30	1.86	2.05	0.39
Relative dispersion	0.39	0.82	0.57	0.71	0.77	0.42
Standard deviation	0.46	1.05	1.65	2.33	2.72	0.51
<i>Tendency</i>						
P > F	26	22	22	18	24	26
P = F	2	1	1	2	1	3
P < F	28	33	33	36	31	27
Implicit prices						
Average growth rate	1.23	1.32	0.43	0.46	0.46	1.07
Average bias	0.01	0.01	0.25	-0.05	0.11	-0.03
Relative bias	0.01	0.01	0.57	-0.11	0.24	-0.02
Average dispersion	0.18	0.39	0.57	1.02	0.80	0.45
Relative dispersion	0.15	0.29	0.68	0.90	0.73	0.42
Standard deviation	0.23	0.65	0.73	1.37	1.16	0.62
<i>Tendency</i>						
P > F	26	23	37	27	30	29
P = F	1	3	1	1	1	1
P < F	29	30	18	28	25	26

Appendix Table 7b. **Statistical properties of revisions: Canada**

Period: Q1 1980 - Q4 1993	Private consumption	Government consumption	Gross fixed cap. formation	Exports	Imports	Gross domestic product
Volumes						
Unbiasedness	-0.03 (0.56)	-0.24 (1.72)	-0.36 (1.65)	-0.33 (1.06)	-0.38 (1.05)	-0.08 (1.25)
Efficiency (beta)	0.02 (0.30)	0.50* (2.46)	0.19* (2.39)	0.38* (5.32)	0.35* (3.85)	0.13 (1.82)
Efficiency (rho)	0.19 (1.43)	0.09 (0.65)	0.05 (0.40)	0.37* (2.90)	0.27* (2.07)	0.10 (0.74)
Prices						
Unbiasedness	0.01 (0.41)	0.01 (0.12)	0.25* (2.52)	-0.05 (0.29)	0.11 (0.71)	-0.03 (0.31)
Efficiency (beta)	0.03 (0.88)	0.23* (3.27)	0.33* (3.73)	0.50* (6.57)	0.43* (6.37)	0.35* (4.50)
Efficiency (rho)	0.19 (1.45)	-0.03 (0.25)	-0.30* (2.35)	0.36* (2.85)	0.19 (1.45)	-0.03 (0.25)

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